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WASTE WATER DISPOSAL PROJECT

KERN FRONT OIL FIELD
FANO LEASE
API: 029-86511
KERN COUNTY, CALIFORNIA

Section 23, T28S/R27E, MDB&M

November 10, 2015

Prepared for:

Badger Creek Ltd.

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1.0 Primary Project Purpose

The primary purpose of this project is to dispose of waste water in the Badger Creek, Ltd (Badger Creek) WD-1 well (API: 029-86511) on the Fano lease within Section 23 of Township 28 South, Range 27 East, Mount Diablo Base and Meridian (MDB&M). A map of the lease and the surrounding properties is shown in Figure 1 below.

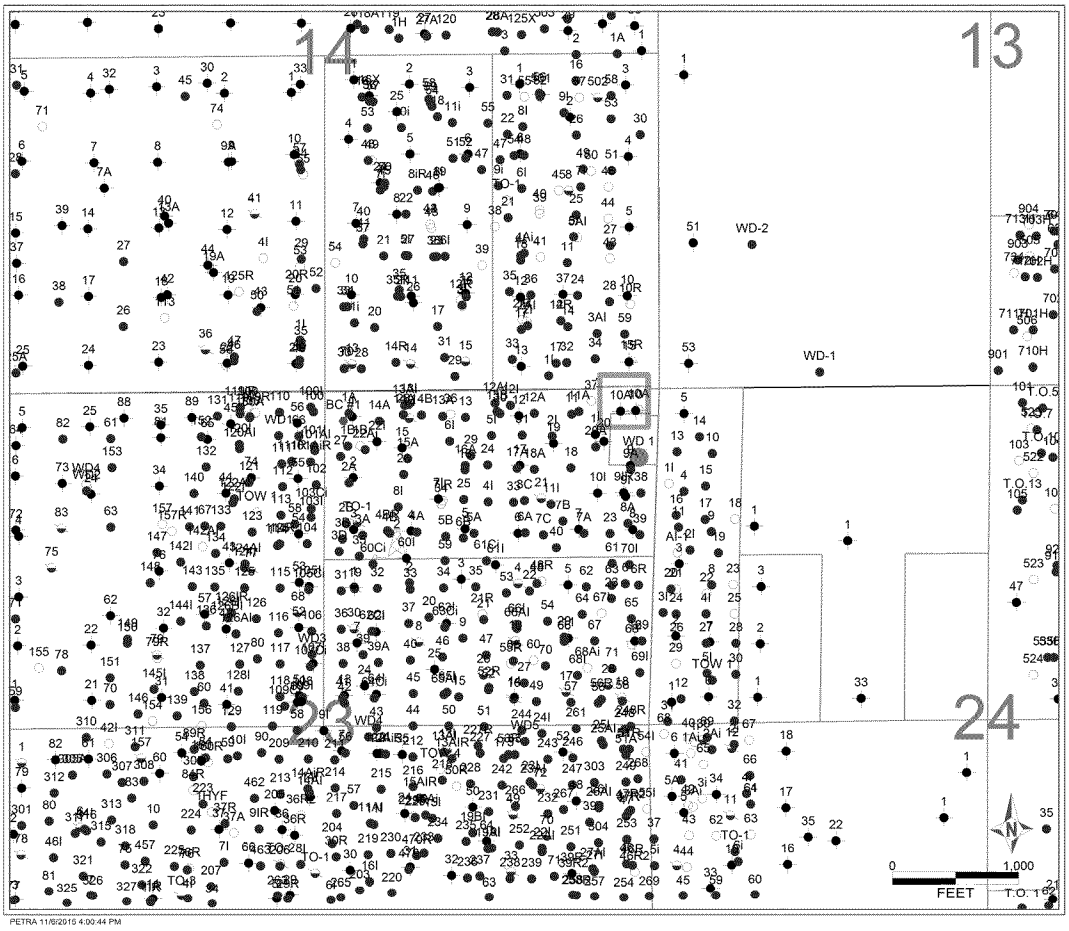

Figure 1: Location Map of Badger Creek Cogeneration Facility. Badger Creek property is highlighted in red.

This Badger Creek Waste Water Disposal Project is designed to confine the water injection to the permitted zone with no movement into or between USDW's within the area of influence. Calculations presented below support the project design. Additionally, the project will comply with all applicable rules and regulations governing the activities. The project will be implemented and operated in a safe manner to ensure that there is no damage to life, health, property, or natural resources.

The following application includes engineering and geologic studies of the reservoir, an injection plan, and details of the source of water that will be used.

2.0 Engineering Study

The target injection zone (Olcese) water has a Total Dissolved Solids (TDS) of 11,000 – 17,000 ppm (Attachment A) and therefore is not classified as a USDW zone. The proposed injection water has an average TDS of ~4,333 ppm (Attachment B).

2.1 Zone of Endangering Influence Calculations

The Zone of Endangering Influence (ZEI) for this project was determined using expected injection rates and volumes, applicable reservoir parameters, and modeling equations accepted by the California Division of Oil, Gas, and Geothermal Resources (DOGGR) and the United States Environmental Protection Agency (USEPA) for pressure build-up and volumetric displacement. Attachment C contains the volumetric and pressure build-up calculations.

Volumetric:

After a 25 year project life the resulting volumetric ZEI radius is 500 feet which is significantly less than a one-quarter-mile radius. There are no wells within one-mile of WD-1 that penetrate the Olcese zone.

Pressure Build-Up:

The closest well to WD-1 that penetrates the Olcese Formation is located 6,328 feet southwest of WD-1. The calculated DP at this distance is 1.6 psi.

Geologic Considerations:

Please see Section 3 for a geologic description demonstrating the lateral continuity of the injection and confining zones resulting in a subsurface structure that will competently contain the injected water far beyond the ZEI.

2.2 Reservoir Characteristics

The following reservoir information is from data gathered by Badger Creek and WZI, Inc. Attachment A includes a table of reservoir parameters from the 1991 UIC Application prepared by WZI, Inc. for Badger Creek WD-1. The reservoir characteristics of the Olcese Formation are summarized below in Table 2-1. Copies of the geochemical analyses for produced water from the Badger Creek well producing from the Olcese Sands are included in Attachment B.

Table 2-1: Olcese Reservoir Characteristics

Olcese Formation Reservoir	
Parameter	**Value**
Maximum Porosity (%)	28
Minimum Porosity (%)	25
Maximum Permeability (md)	500
Minimum Permeability (md)	250
Fracture Gradient, psi/ft	0.8
Average Net Sand Thickness (ft)	240
Measured Depth to Top of Olcese (ft)	3,500
Elevation to Top of Olcese (ft)	-2,600
Average Depth (ft)	3,675
Original Temperature (°F at average depth)	111
Present Temperature (°F at average depth)	111
Original Pressure (0.433 psi/ft)	1,515
Present Pressure (0.433 psi/ft)	1,515
Fracture Pressure (0.800 psi/ft)	2,800
Maximum Surface Pressure (psi)	1,285
Residual Oil Saturation (%)	<1
Residual Gas Saturation (%)	0
Water Saturation (%)	>99
Maximum Total Dissolved Solids (ppm)	17,000
Minimum Total Dissolved Solids (ppm)	11,000

* Values from WZI, Inc. report in 1991, shown in Attachment A.

2.3 Reservoir Fluid Data

An Olcese formation fluid sample collected by WZI while drilling the Badger Creek well WD-1 in 1990 shows a TDS value of 15,800 mg/l (ppm). The sample was collected from a drill-stem-test at a depth of 3,555 to 3,575 feet by WZI, Inc. and analyzed by Zalco Laboratories, Inc. (Attachment D).

Additional salinity TDS of the Olcese formation water was determined from published DOGGR geochemical data (California Department of Conservation, 2011).

An Olcese Formation reservoir fluid sample collected from well E & M Lease WD-1 (API: 030-34633) within the Kern River Oil Field was analyzed by Zalco Labs for E&B Natural Resources in 2010, indicating a TDS value of 7,500 ppm. The laboratory notes that the formation fluid appears to have been contaminated with fresher water, creating a lower TDS value than that of the formation fluid.

An analysis conducted in 1977 for Getty Oil Company from the SJWD-1 well (API: 029-53911) within the Kern River oil field indicates a TDS value of 12,568 ppm. Copies of the analyses are included in Attachment D.

2.4 Planned Well Drilling and Abandonment Program

No well drilling or abandonment is planned for this project. After project approval, Badger Creek WD-1 will be recompleted in the Olcese Formation.

2.5 Casing Diagram

There are no oil and gas production wells that penetrate the Olcese Sand within a one-mile radius from WD-1, therefore, no casing diagrams are presented for wells other than WD-1. A casing diagram for WD-1 is included in Attachment E. The casing diagram includes the proposed perforations within the Olcese Formation. All 358 wells within the AOR are completed at depths shallower than the Olcese, and would not serve as potential pathways for the migration of fluid from the WD-1 injection well completed within the Olcese Formation. A map of the AOR with a one-mile radius from WD-1 is shown in Figure 2, the sub-sea total depth of each well is posed in blue.

A list of oil wells and their respective total depth measurements (TD) within one-mile radius of WD-1 is included in Attachment F. A structure contour map constructed of the top of the Olcese Formation is shown in Exhibit 1.

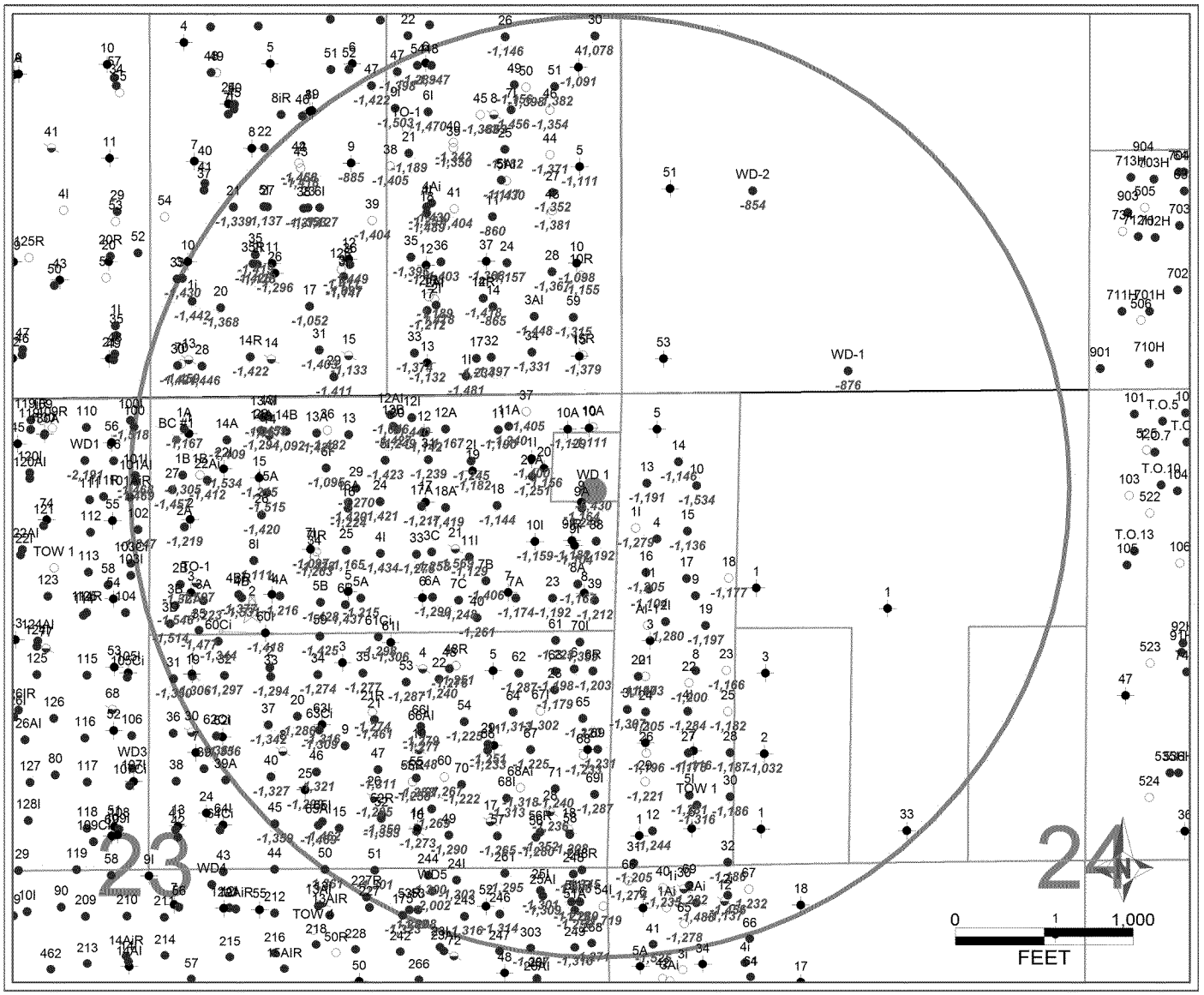

Figure 2: One-mile radius from well WD-1, highlighted in orange, with posted total depth (subsea value) of each well. No wells within this radius penetrate the Olcese Formation.

3.0 Geologic Study

A geologic study for the project including structure contour and isopach maps for the anticipated injection zone, and cross-sections were constructed by EnviroTech Consultants, Inc. The intended water injection zone is within the Olcese Sand.

3.1 Type Log

A type log, the electric log from Badger Creek WD-1, is included in Exhibit 2.

3.2 Geologic Structure Map

The Olcese sands dip gently towards the southwest at approximately 2,000 - 2,500 feet below sea level in the project area. A structure map drawn on the top of the Olcese Formation is included in Exhibit 1. The proposed injection zone (Olcese) within the WD-1 is on the east side of the fault trapping the oil in the Chanac Formation within the Kern Front Oil Field.

3.3 Isopach Map

The net sand thickness of Olcese Formation within the project area is approximately 312 feet thick. An isopach map is included in Exhibit 3.

3.4 Geologic Description

The early to middle Miocene Olcese Formation consists of friable, poorly consolidated, fossiliferous, sand with interbedded pebbly sand and siltstone. The Olcese Formation intertongues with its underlying strata, the Freeman Silt, and with its overlying strata, the Round Mountain Silt (Addicott, 1970; Prothero et al., 2008).

The interpreted depositional environment of the Olcese Formation is a shallow marine shelf environment. Three members are recognized within the Olcese Formation: the lower member, which is composed of gray, very fine marine silty sandstone; the middle member, which is abundantly cross-bedded and composed of fine to coarse pumiceous sandstone with gravel; the upper member, which is highly fossiliferous and is composed of very fine grained sand (Prothero et al., 2008).

The Olcese Formation is thickest along the eastern San Joaquin Basin, eventually pinching out basinward.

Two detailed structural cross sections, A-A' and B-B', are included on Exhibit 4 and 5, respectively.

4.0 Injection Plan

4.1 Maximum Anticipated Number of Injection Wells

This project includes one injection well.

4.2 Maximum Anticipated Daily Injection Volume

The maximum anticipated daily water injection volume is 1,667 barrels of water per day with a project life average of 939 barrels of water per day.

4.3 Maximum Anticipated Surface Injection Pressure and Daily Rate of Injection by Well

The maximum surface injection pressure for the well will not exceed the pressure required to induce a hydraulic fracture of the receiving formation as calculated at the uppermost perforation depth of the injection well.

The shallowest uppermost perforations for this project will be 2,248 feet vertical depth. The pressure required to initiate a hydraulic fracture at any depth is based on a gradient of 0.8 psi/ft. The injection water has a gradient of 0.441 psi/ft. As the depth of the top of the perforations is 2,248 feet vertical depth, the maximum anticipated bottom-hole injection pressure measured at the top perforation will be 1,798 psi. Based on an injection water gradient of 0.441 psi/ft the maximum allowable surface injection pressure (MASP) is 807 psi plus friction pressure loss in the tubing as follows:

(0.8 – 0.441) x 2,248 = 8.07 psi + friction loss

The friction pressure loss at this depth is negligible and any friction effect will be an additional safety factor to the MASP.

To confirm that the injection fluid is confined to the Olcese Formation:

- Mechanical integrity testing will be performed on the injection well upon commencement of injection and annually thereafter.

- Standard Annular Pressure Tests (SAPT) will be performed on the injection wells prior to commencement of injection and at least once every five years thereafter at Maximum Allowable Surface Pressure (MASP) to ensure mechanical integrity of tubing, casing, and packer.

- A Spinner-Temperature-Radioactive Tracer log will be performed annually to monitor injection profile and ensure top perforation and packer are containing the fluid to the permitted injection zone.

- In addition, all injection piping, valves, and facilities, will meet or exceed design standards for the maximum anticipated injection pressure, and will be maintained in a safe and leak-free condition.

4.4 Injection Facility Map

A map showing the injection facilities is included as Figure 3 (below). The injection facilities consist of a 40,000 gallon waste water tank, three FMC positive displacement injection pumps and piping with pressure gauges. Only one FMC injection pump runs at a time. The entire cogeneration plant, including the injection facilities, is surrounded by five foot high berms.

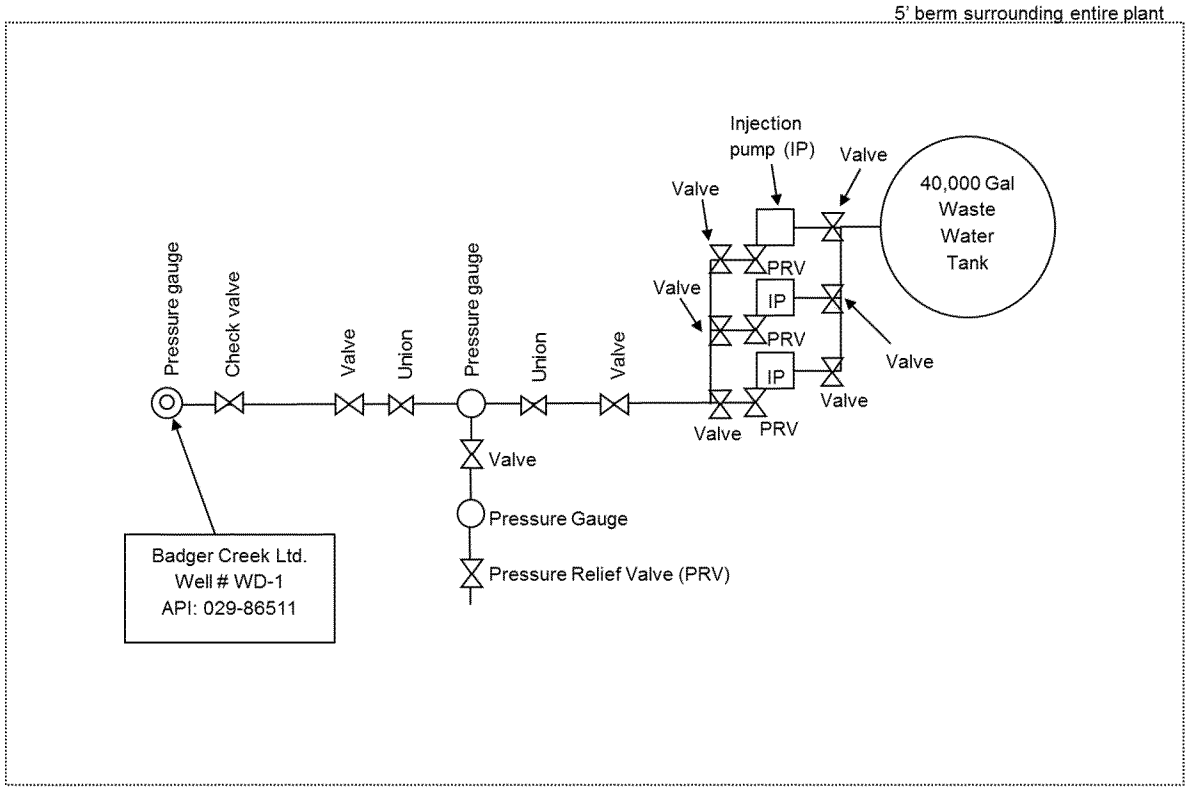

Figure 3: Injection Facilities Map

4.5 Monitoring System

A pressure gauge is installed on the tubing to monitor injection pressure and a pressure gauge will be installed on the annulus to monitor the annulus pressure. These pressures will be observed and recorded daily.

4.6 Methods of Injection

The waste water is delivered to the injector well via pipeline from the waste water tank. The waste water will be injected through tubing below a packer set within 100 feet of the uppermost perforation.

4.7 Proposed Cathodic Protection (Corrosion protective measures)

- No cathodic protection will be used for the distance from the tank to the injection well (30 feet).
- Oxygen present in the system will be minimized.

The project will be evaluated for protection measures as warranted. Corrosion within the wells and piping will be controlled by inhibition with appropriate chemicals as determined by testing.

4.8 Treatment of Water to be Injected

Wastewater is pressure filtered, demineralized, and neutralized prior to injection and treated with a scale inhibitor.

4.9 Source of Injection Fluid

The source of water injected is the Badger Creek cogeneration facility. The source of water for the facility is from a water well, located approximately 0.5 miles west from WD-1. Badger Creek will obtain approval from the DOGGR for any new water disposal wells through the applicable permitting processes and the Annual Project Review.

4.10 Analysis of Injection Fluid

Historic analyses of waste water injected into WD-1 are included in Attachment B. Waste water injected into the Olcese Formation will be from the same source.

5.0 Water Sampling Procedures

A representative sample of wastewater was collected on 8 July 2015. The waste water sample was taken at the injection well WD-1. The sample was decanted into appropriate sampling containers and cooled with ice for storage and transportation under standard chain of custody procedures. The sample was delivered to TestAmerica Laboratories on 8 July 2015.

Due to the sample being taken directly from an outlet on the pipe for the wastewater sample, there was no waste management needed and no water to dispose.

The water samples were analyzed by TestAmerica Laboratories as follows:

- Total Dissolved Solids,
- Metals listed in California Code of Regulations, title 22, section 66261.24, subdivision (a)(2)(A),
- Benzene, toluene, ethylbenzene, and xylenes,
- Total petroleum hydrocarbons for crude oil,
- Polynuclear aromatic hydrocarbons (including acenaphthene, acenaphthylene, anthracene, benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, dibenzo[a,h]anthracene, fluoranthene, fluorine, indeno [1,2,3-cd]pyrene, naphthalene, phenanthrene, and pyrene),
- Radionuclides listed under California Code of Regulations, title 22, Table 64442,
- Methane,
- Major and minor cations (including sodium, potassium, magnesium, and calcium),
- Major and minor anions (including nitrate, chloride, sulfate, alkalinity, and bromide),
- Trace elements (including lithium, strontium, boron, iron, and manganese).

The complete laboratory reports are included in Attachment B. The laboratory analytical report shows that the waste water injectate is high in TDS, sodium, and chloride.

The Stiff Diagrams below are shown for wastewater injectate for WD-1 (Figure 4) and Olcese Formation fluid at WD-1 (Figure 5).

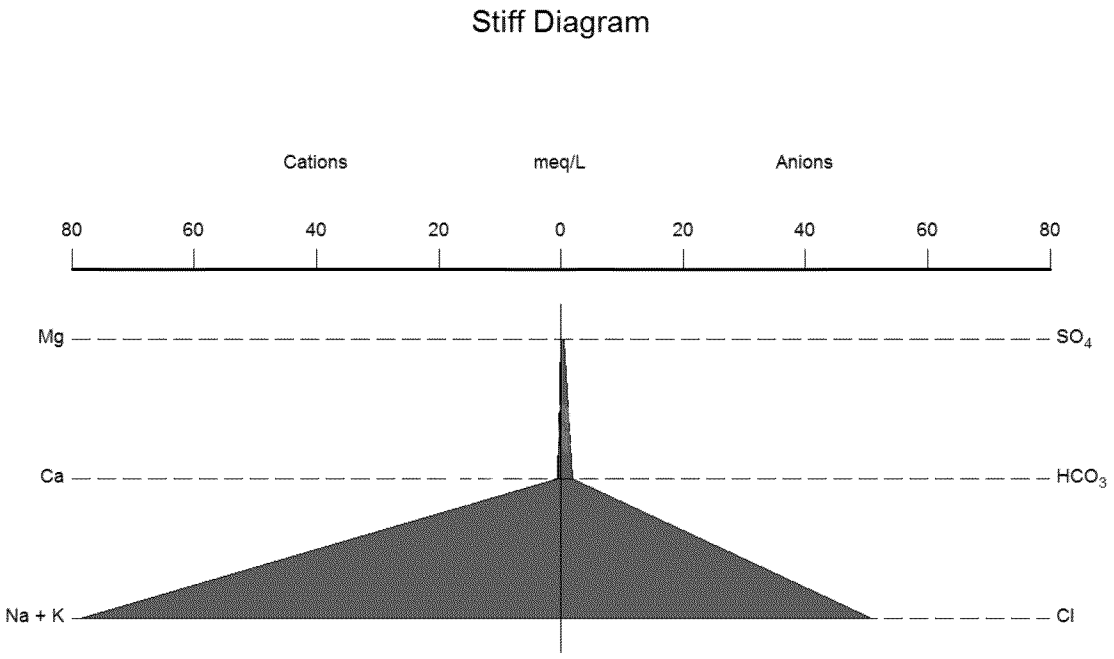

Figure 4: Stiff diagram of waste water injectate sample at WD-1

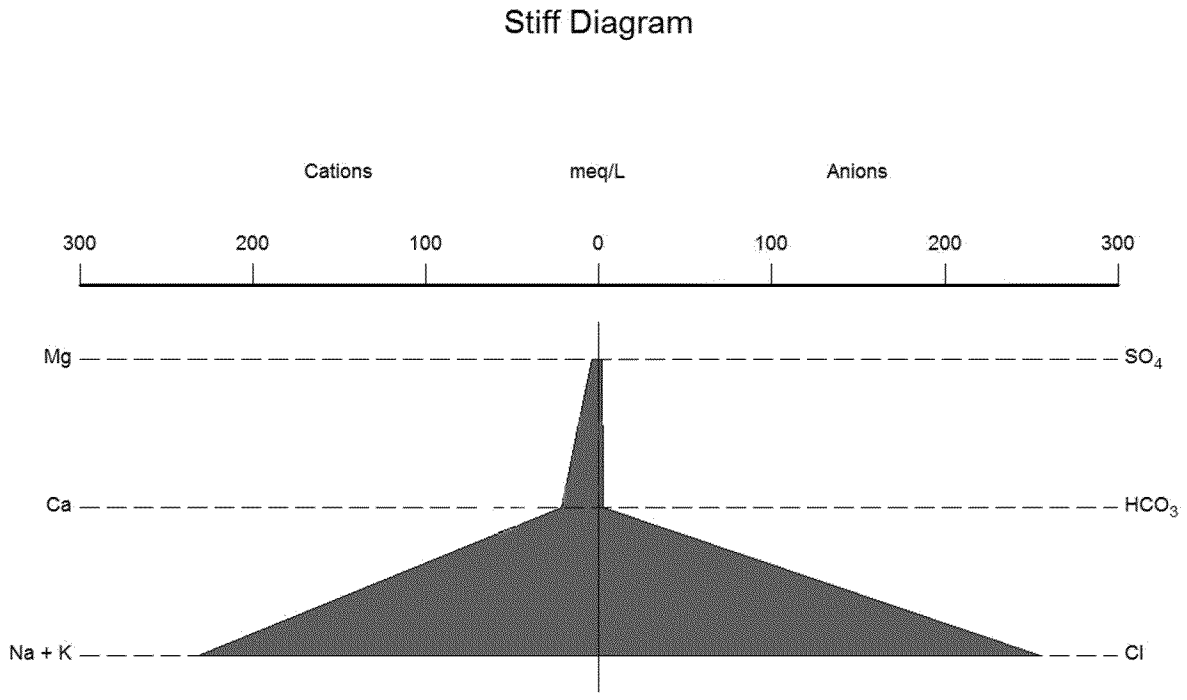

Figure 5: Stiff diagram of Olcese formation fluid sample BC-4 at WD-1

6.0 Water Well Survey

This report also documents the results of a water well record investigation conducted within a one mile radius of the WD-1 well. The result of this investigation concludes that 6 domestic water supply wells exist within a 1 mile radius of the injection well.

The information for each identified water supply well is included on a spreadsheet in Attachment G. Data for each water supply well includes the following, where available: the well owner name and contact information; type of well (i.e., domestic, irrigation, industrial, etc.); whether any of the water is used for domestic purposes; status (i.e., active, idle, etc.); well construction details; borehole geophysical logs; and all analytical results for any water sample(s) collected from each water supply well.

The screened portion of all existing water supply wells is more than 1,800 feet vertically above the proposed injection zone. This UIC project will not impact the water supply wells.

7.0 Letters of Notification

There are three offset operators within a 1/4 mile radius of the injection well. Letters of Notification will be sent to Chevron USA, California Resources Corporation, and ExxonMobil Corporation. Copies of the letters of notification sent to the offset operators and confirmation of their receipt are in Attachment H.

8.0 References

Addicott, W.O., 1970, Miocene Gastropods and Biostratigraphy of the Kern River Area, California, United States Geological Survey Professional Paper 642

D4 Chemcial Analysis, Kern River, 2011, California Department of Conservation Division of Oil, Gas & Geothermal Resources, ftp://ftp.consrv.ca.gov/pub/oil/D4%20Chemical%20Analysis/Kern%20River/Kern%20River%20-%20Olcese%20zone.pdf

Prothero, D.R., Sanchez, F., Denke, L.L., 2008, Magnetic Stratigraphy of the Early to Middle Miocene Olcese Sand and Round Mountain Silt, Kern County, California, Neogene Mammals, New Mexico Museum of Natural History and Science, Bulletin 44.

ATTACHMENT A

Reservoir Parameters, Kern Front Oil Field

ATTACHMENT B

Geochemical Analyses, Injectate

ATTACHMENT C

Zone of Influence Calculations

ATTACHMENT D

Geochemical Analysis, Formation Fluid

ATTACHMENT E

Casing Diagram

ATTACHMENT F

Oil and Gas Wells within One-Mile of WD-1

ATTACHMENT G

Water Well Survey

ATTACHMENT H
Letters of Notification

EXHIBIT 1
Top of Olcese Structure Map

EXHIBIT 2
Type Log, Well WD-1

EXHIBIT 3
Olcese Formation Isochore Map

EXHIBIT 4
Stratigraphic Cross Section A – A’

EXHIBIT 5
Stratigraphic Cross Section B – B’